Physicochemical Properties of Compost Substrates of *Spondias Mombin* Wood Dust with Cow Dung for the Cultivation of Edible Mushroom *Pleurotus Ostreatus*

Olabode, O.O.1 Adegunloye, D.V.2 Akinyele, B. J.2 and Akinyosoye, F.A2
1Integrated Science Department, Adeyemi College of Education, P.M.B. 520, Ondo, Nigeria.
2Department of Microbiology, Federal University of Technology, P.M.B. 704, Akure, Nigeria

ABSTRACT

Composting process prepared by passive pile method was carried out using wood dust of *Spondias mombin* and cow dung as booster. *Eudrillus Eugenie* which are fast breeders and active feeder on organic matter that are high in nitrogen was used for the vermiculture. Substrates were prepared with varying ratio of wood dust:animal waste and kept on outdoor shelf for a period of 10 weeks for composting and vermicomposting. The temperature reached a maximum of 38.0 °C in 4 days of the process in composted substrate at ratio 9:1 of wood dust: cow dung and dropped to 25.5 °C in vermicomposting substrate of *Spondias mombin* and cow dung ratio 6:4 at 40 and 70 days. The pH also reached a maximum of 8.75 on composted wood dust of *Spondias mombin* and cow dung ratio 9:1 from day 40 through day 50. Compost increased in Carbon: Nitrogen ratio of substrate, reduced the fat content, and increased crude protein, ash and fibre content with more carbon from wood waste at the end of the period of composting. Composted wood dust of *S. mombin* and cow dung ratio 5:5 recorded increase in percentage nitrogen from 5.85±0.01% to 6.09±0.04%, as the ratio of wood dust of *S. mombin* decreased. Composting also increased the Iron, copper and Zinc content of the final product. Composting of substrates with high Carbon:Nitrogen ratio encourages cultivation of mushroom. Vermicomposting showed to produce substrates with desired nutrient that supports the growth of fungi It therefore makes the attempt to cultivate tropical mushroom *Pleurotus ostreatus* more desirable.

Key Words: Animal Wastes, Edible, Wood Waste, Substrate, Vermiculture,

1. INTRODUCTION

A large quantity of agricultural waste and lignocellulosic residues are produced through the activities of various industries. In Nigeria, these are either disposed of by burning or dumped in sites where they can pose hazard to the environment and human health. Cultivation of saprophytic edible mushroom may only be the only currently economically biotechnology for lignocellulose organic waste recycling that combines the production of protein rich food with the reduction of environmental pollution (Obodai and Apetogbor, 2003).

Several agro industrial wastes could be used to prepare mushroom composting (Gbolagade et al., 2011). Lignocellulosic wastes from tree wood dust are abundantly available in Nigeria for composting. Composting organic matter wastes is an important pathway for carbon flow and cycling of nutrients, both in industrial and developing countries (Bonito G. et al., 2010). The biochemical decomposition of organic matter is primarily accomplished by microorganisms, but earthworms are crucial drivers of the process as they may affect microbial decomposer activity by grazing directly on microorganisms (Aira et al, 2009; Monroy et al., 2009; Gomez-Brandon et al., 2011a).

Micro enzymes are part of all natural ecosystems, the biocenosis are significant and essential for biochemical elements, responsible for the entirety of biogenic element transformation in soil environment, and which exert critical effects on biochemical activity, ecological stability, and biological productivity of many field, forest and grassland ecosystems. They are involved in biochemical transformations of mineral fertilizers, particularly NPK fertilizers, synthesis of biologically active substances (amino acids, vitamins, antibiotics, toxins) and nitrogen fixation from the air. They regulate element circulation in soil environment and make them assimilates for plants (Okore, 2014). The main purpose of composting is to prepare a substrate in which the growth of mushroom is promoted to the practical exclusion of the microorganisms (Obodia,2010). *Pleurotus species* are a rich source of protein, minerals (P, Ca, Fe, K, and Na) and vitamin (thiamine, riboflavin, folic acid, and niacin)(Szabova et al.,2013) They are specie are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency (Mane et al., 2007). *Pleurotus species* are efficient lignin degraders which can grow on wide variety of agricultural waste. Lignin is the second most abundant constituent of the cell wall of vascular plants (Martinez et al., 2009).

Saprophytic mushrooms are found growing on rotten logs of woody tree trunks, decaying or dead organic matter and dump soil rich in organic substances. Mushroom has been established to grow and fruit on various agricultural wastes (Moncaio et al., 2005). Several agro industrial wastes could be used to prepare mushroom compost (Gbolagade et al., 2011).
Lignocellulosic wastes from tree wood dust are abundantly available in Nigeria for composting.

Oyster mushroom (Pleurotus species) belongs to the family of Tricholomataceae and is the second widely cultivated mushroom worldwide following the Agaricus bisporus (Sanchez, 2010). Pleurotus species can efficiently degrade agricultural wastes and they grow at a wide range of temperatures [Sanchez, 2010]. In comparison to other edible mushrooms, Pleurotus species need a short growth time and their fruiting bodies are not often attacked by diseases and pests (Tesfaw et al., 2015). Pleurotus species require carbon, nitrogen and inorganic compounds as their nutritional sources. Oyster mushroom can grow on a wide variety of substrate. However, the yield and the quality of oyster mushroom depend on the chemical and nutritional content of substrates (Badu et al., 2011; Patil et al., 2010). Hai Thi Hoa (2015) observed the presence of Ca, Cu, Fe, K, Mg, Mn, P, and Zn as mineral content of substrate in his study of the effect of different agro-wastes on the growth of oyster mushroom. Salas-Campos et al., 2009 confirmed in their study that these elements are naturally present in all the raw materials used for preparation of the cultivation substrate. Potassium is available for the fungus usually in the form of phosphate (0.0001-0.0004M). This mineral is very important because it is a co-factor of several enzymatic systems, being the most abundant macrolelement in mushrooms (Zhang et al., 2002). Therefore the objective of this present work is to determine the effect of composting on the nutrient status of substrates prepared for commercial cultivation of Pleurotus ostreatus from the wood of Spondias mombin.

2. MATERIALS AND METHODS

2.1. Collections of animal and agricultural wastes

Cow dung was collected inside sterile polythene bags from the animal farm in Pele village located in Ondo West Local Government Area of Ondo State, Nigeria. Sawdust of Spondias mombin (African nut) was collected in clean bags from sawmills at Oka, Ondo where the wood was milled into 5 mm sizes. Cow dung was transferred to the laboratory for composting and vermicomposting preparation.

2.2. Compost preparation

The composting was prepared by passive pile method (Keith et al., 2009). One kilogram of compost substrate was prepared by mixing wood waste of Spondias mombin and the cow dung (A), in the ratio of 5:5,6:4,7:3,8:2,9:1 (numbered as 1,2,3,4 and 5) respectively and the control sample was 100% wood dust. The various samples were composted in plastic bowls and observations were made daily for 70 days. The compost was kept at moisture of 65% and ambient room temperature. Temperature of the core were taken daily during the period of the experiment. Samples of the compost were taken daily for proximate and chemical analyses.

2.3. Vermiculture

Eudrilus eugenie identified as a fast breeder and active feeder on organic matter that are high in nitrogen was used for the vermiculture (Jambhekar 1992). Earthworm culturing was done under shelter to avoid direct sunlight and heavy downpour using fifteen litre plastic buckets with perforated lid. A bed of 10cm height using sawdust as the base was sprinkled with water to get a moisture level of 40-45% which made the bed to appear wet. Different substrate preparation of Pycnanthus angolensis were mixed with the cow dung in equal quantity with appropriate quantity of water to make a homogenous mixture. The mixture was kept for two weeks, while the material was turned 2 to 3 times at 4-5 days interval. This was transferred on the layer of beddings prepared earlier. Worm was introduced into the prepared culture. The worm fed actively on the organic matter and bred (Henamgee, 2003).

2.4. Vermicomposting

Composting heaps of the various substrates were made inside plastic bowl at the rate of 10 worms/kg of feed mix (substrate). It was kept wet to a moisture level of 70% for 60 days (Henamgee, 2003). The vermicompost formed completely gave the smell of moist soil. Samples were taken during the period of vermicomposting for 70 days for bacteria isolation and identification.

2.5. Substrate samples

Composted wood dust of Spondias mombin and cow dung (CSA), Vermicomposted samples of the wood dusts and organic wastes were prepared like the compost as VSA, CSco, and VSCo were 100% samples of wood dust without dung used as control.

2.6. Determination of the physical characteristics of composts and vermicomposts

The colour, texture and odour of substrates were determined before and after composting. The physical characteristics of the substrate samples were determined using the methods adopted by Sadiq and Malami (2009).

2.7. Determination of the temperature of compost and vermicomposts

The temperatures of the samples were taken and recorded at different sampling point. A mercury-in-glass thermometer was dipped into the compost and vermicompost piles to a depth of 25 cm to determine the temperature of each sample.

2.8. Determination of the pH

This was determined using pH meter (model 3015, Jenway, UK). One gram of the soil sample was placed in a beaker, then 10ml of distilled water was added and the mixture was stirred. It was allowed to stand for 30 minutes. A buffer solution was used to calibrate the pH meter. Then the electrode of the pH meter was inserted into the mixture and the pH readings were taken and recorded.

2.9. Moisture content

The moisture content of compost and vermicompost were determined by standard method of AOAC, 2005.

The moisture content was determined by using oven drying method which is based on weight loss of water due to evaporation. Clean and dry dishes were weighed by using
Mettler balance and their respective weights were recorded (W1). Four grams of the sample (composts and mushroom) were weighed into respective glass dishes (W2) spreading as much as possible and transferring into a desiccator immediately after each weighing, until all weighing were completed to prevent absorption of moisture from the atmosphere. The glass dishes containing the sample were transferred from desiccators into the oven maintained at 105°C and dried in the oven until constant weights (W3) were obtained. The loss in weight during drying in % was taken to be % moisture content

\[
\text{% moisture} = \frac{\text{loss in weight due to drying}}{\text{Weight of sample taken}} \times 100 = \left(\frac{W_2 - W_3}{W_2 - W_1}\right) \times 100
\]

### 2.10. Determination of macro and micronutrients

The analyses of macronutrients (Ca, Mg, P and K) and micronutrients (Na, Fe, Cu, Mn and Zn) were carried out in triplicate, following the same protocol used for the analyses of soil and plants (Malavolta et al., 1989) in order to verify the presence of mineral compounds. Samples were dried and finely crushed in a Willey knife mill, for further digestion and analyses at the Laboratory of Soils and Plants. Samples were weighed (0.5g), digested with nitric-perhydro acid mixture and solubilized. Ca, Mg, Fe, Cu, Mn and Zn contents were determined by means of atomic absorption spectrophotometry, Na and K by atomic emission, and P by UV-visible colorimetry, all previously calibrated with standard solutions for each element (AOAC, 2010). Macronutrients (Ca, P, Mg and K) values were calculated in percentage and micronutrients (Na, Fe, Cu, Mn and Zn), in mg kg⁻¹.

### 2.11. Proximate analysis

Analyses of moisture, protein, fat, crude fibre, total carbohydrates, ash of samples were determined by standard methods (AOAC, 2010). All determinations were done in triplicates. Total soluble carbohydrate was determined by the difference of the sum of all the proximate composition from 100%. The calorific (energy) value was obtained according to the methods of Akinyeye et al., (2010) and Akinyeye et al.,(2011). This was done by multiplying the value of carbohydrate, protein and crude fat by the Atwater factors of 17.17 and 37 respectively (Akinyeye et al.,2011 and kilgour,1987). The crude fat was converted into fatty acid by multiplying with conversion factor of 0.8 as described by Akinyeye et al.,(2010) and Akinyeye et al.,(2011) and Greenfield and Southgate (2003). The proximate determinations were performed in triplicates. All the proximate values were reported in percentage.

### 2.12. Statistical analysis of results

All data generated were analysed statistically as described by the method of Olawuyi (1993). Statistical values that were calculated include mean, standard deviation and standard mean.

### 3. RESULTS AND DISCUSSION

The results showed that a change in pH was observed during the process of composting and vermicomposting from 0 to 70 days with different substrate mix for S. mombin wood dusts with cow dung. The pH of compost ranges between neutral to slight alkaline during the period of composting and vermicomposting for all substrates. The pH of vermicomposting preparation came to neutral, from its initial slightly alkaline, to as low as 6.9 in CSA5 and VSA5 during the period (Fig. 1 and 2). The mean pH of vermicompost is lower than the observed for compost. There is no significant difference in the pH of compost substrate preparations and the control for S. mombin with cow dung.

The results further showed that the compost with 50% wood dust, ratio (5:5) had a constant increase from pH of 7.8 to pH of 8.5 as the experiment continued from day zero through day seventy. This was closely followed by the formulation of 6:4. This trend was not observed by day 60 as the sample of ratio 7:3 had the highest pH of 8.3. However, by day 70, the sample of ratio 5:5 had the highest pH of 8.6. The pH of vermicomposting preparation came to neutral from its initial slightly alkaline state and slightly lower than the observed pH of composting, which came to as low as 6.5.

The recommended pH for vermicompostong is around 6-7 (Borah, 2006). Bacteria residing in the gut of the earthworm must have accounted for reduced pH). Atiyeh et al.,(2000) documented reduced pH and C:N ratio in manure subjected to earthworm activity. Lazcano et al., (2008) explained that a slight decrease in pH values of vermicomposting compared to traditional composting might be attributed to mineralization of N and P, microbial decomposition of organic material to intermediate organic acid, fulvic acids and humic acids. The temperature of vermicomposting substrate is lower than the temperature of control for each substrate.
3.1. Effect of period of composting on the temperature of compost substrates

Changes in temperature were observed during the process. The various substrates prepared for composting and vermicomposting undergo changes in temperature during the period (0 to 70 days). A general rise in temperature was observed in all substrate compositions for both wood dusts in the first 5 days of composting (Fig. 3 and 4). *S. mombin* substrates rose to a highest temperature of 38.0°C while the least temperature of 25.5°C on day 40 was observed in composting wood dust of *S. mombin* and cow dung (CSA1). There is no significant difference in the temperature of composting and vermicomposting in all substrate mix. The temperature of composted samples reduced generally after 10 days of composting, after which there were no significant changes. There is no significant difference in the temperature of composted substrate and the control for composting and vermicomposting after 10 days. The temperature of vermicomposted substrates are slightly lower than the composted ones. It is also lower than the temperature of the control for each substrate.

This pattern was followed or observed for all the experimental treatments. This result is similar to the result obtained by Fasidi (2005) when he assessed the effect of temperature on agricultural wastes for the cultivation of edible mushrooms.
The temperature that started dropping in the compost pile before the material was stabilized, could indicate that the pile was becoming anaerobic and should be aerated by turning (Adegunloye, 2009). Therefore, turning was performed at regular intervals. The results indicated that processes like thorough mixing of the materials and turning enhanced the decomposition process. Moreover, if turning process failed to reheat the composting pile, it showed that the composting material was biologically stable (Adegunloye, 2007).

A change in temperature that was observed during the process of composting and vermicomposting was confirmed by Nagavallema et al, 2004. Since dung were added to wood dust, these causes increase in the nutrient for resident bacteria and fungi to increase in number and a consequent rise in temperature.

This general initial rise in temperature of substrate during the early stage of composting may be due to activation of microbes in a fresh medium, initiating a rapid early mineralisation of organic C and N. A mesophilic temperature of 28-44°C in the composting is able to accelerate the growth of mesophilic microbes. Ivors et al., (2000), observed a similar rise in temperature, while working on fermented agricultural substrates used for the cultivation of *Agaricus bisporus*. Gbolagade (2006) in his work with saw dust and wheat bran substrate observed that the temperature increased steadily and attained its highest value (60°C) on the 5th day of composting process and a gradual decrease was observed from the 6th day until the end of the process (14th day). Temperature has significant effect on succession of microorganism involved in fermentation process. Bacteria activity is greatly dependent on temperature. It plays a vital role in composting and vermicomposting.

![Figure 21: Effect of period of composting on temperature of *Spondias mombin* wood dust and Cow (CSA).](image)

**Key:** CSA1 - *Spondias mombin* and cow dung ratio 5:5; CSA2 - *Spondias mombin* and cow dung ratio 6:4; CSA3 - *Spondias mombin* and cow dung ratio 7:3; CSA4 - *Spondias mombin* and cow dung ratio 8:2; CSA5 - *Spondias mombin* and cow dung ratio 9:1; CSco 100%

![Figure 29: Effect of period of vermicomposting on temperature of *Spondias mombin* wood dust and Cow dung](image)

**Key:** VSA1 - *Spondias mombin* and cow dung ratio 5:5; VSA2 - *Spondias mombin* and cow dung ratio 6:4; VSA3 - *Spondias mombin* and cow dung ratio 7:3; VSA4 - *Spondias mombin* and cow dung ratio 8:2; VSA5 - *Spondias mombin* and cow dung ratio 9:2; VSco 100%
3.2. Effect of composting on proximate composition of compost substrates

The results obtained from the proximate composition of the compost showed that the various compositions have significant effects on the amount of fat, protein, moisture content and other parameters tested for between the initial and final content. Fat content of substrates reduced with composting as ratio of animal waste increases at the end of composting. In composting ratio 9:1, the final fat content was 6.71±0.01 as compared to 0.875±0.015% in vermicomposting. The amount of fat reduced further in vermicomposted substrates at the end of the experiment (Table 1 and 3). Composted wood dust of S. mombin and cow dung ratio 5:5 recorded the least percentage of fat (1.17±0.03). The highest protein was found in compost substrate of ratio 9:1 (CSA5) (Table 1). The amount of protein reduced to a least in vermicomposted substrates of the same ratio. There was a significant difference in mineral and proximate composition and properties among substrate formulations used in this study. The reduction in the fat and crude protein content of substrates after composting and vermicompost show that proteolytic bacteria that were present must have released enzymes that degrade protein to release gaseous oxides of nitrogen and sulphur, thereby remove the order of organic waste associated with dung of animal. There is a reduction in the organic matter of the substrate which is due to carbon dioxide and water loses during bacteria and fungi metabolism. There was no significant difference in the moisture content of the composted wood dust and cow dung at varying ratios. Ash content decreased with composting as the animal waste ratio reduces, the highest ash content of 5.52±0.02% was found in vermicomposted substrate mix 8:2 (VSA4). Composting reduced the fibre content, while vermicomposting increased it after a period of 70days, except in the control substrate VSco. Fibre content of compost reduced as animal waste ratio increased.

The mineral composition of the compost of wood dust S. mombin and cow dung showed the presence of nitrogen, phosphorus, potassium, sodium, calcium, magnesium, copper and zinc in the substrates. Quantitatively, the amount of nitrogen was noticed to increase between the initial and final values gotten for all the ratio formulations in composting and vermicomposting. Composted wood dust of S. mombin and cow dung ratio 5:5 recorded increase in percentage nitrogen content from 5.85±0.01% to 6.09±0.04%, as the ratio of wood dust of S. mombin decreases, this pattern of increase in the nitrogen content between the initial value and the final value continued. For example, composted wood dust of S. mombin and cow dung ratio 9:1 increased in percentage nitrogen from 3.18±0.02% initial content to 3.53±0.01% in the final content.

The same pattern was observed for phosphorus, potassium, and calcium. Their level or amount increased significantly as the ratio of wood dust to cow dung increases, except for sodium that a decrease was observed as the ratio of wood dust to cow dung increased. Vermicomposting resulted in increase in observed for phosphorus, potassium, sodium, calcium and magnesium, copper and iron. The amount of zinc reduces as ratio of wood dust increases. These results are shown in Tables 2 and 4 and it is supported by the work of Chandna et al., (2013), during composting of agricultural byproducts. Changes were observed in carbon (C), total nitrogen (N), the C: N ratio, phosphorus and potassium. Janakiram and Stridevi (2010) observed similar result during the composting of Jatropha curcas with slurry of cow dung by an aerobic composting method, where the percentages of N, P, Na, Ca and Mg increased after 30 and 60 days of composting. Hai Thi Hoa et al., (2015) observed the presence of Ca, Cu, Fe, K, Mg, Mn, P, and Zn as mineral content of substrate in his study of the effect of different agro-wastes on the growth of oyster mushroom. It was also confirmed by the work of Ceci et al., (2009). These mineral nutrients were present in all the raw materials used. They are also present in this present study at the end of composting and vermicomposting at quantities higher than the observed in the substrates used by Ceci et al., (2010).
Table 1: Proximate composition of compost (S. mombin wood dust and cow dung)

<table>
<thead>
<tr>
<th>Substrates</th>
<th>fat content</th>
<th>crude protein</th>
<th>moisture content</th>
<th>ash content</th>
<th>fibre</th>
<th>dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Final</td>
<td>Initial</td>
<td>Final</td>
<td>Initial</td>
<td>Final</td>
</tr>
<tr>
<td>CSA1</td>
<td>1.30±0.02</td>
<td>1.17±0.03</td>
<td>9.56±0.02</td>
<td>20.74±0.01</td>
<td>44.60±0.00</td>
<td>44.49±0.00</td>
</tr>
<tr>
<td>CSA2</td>
<td>1.71±0.02</td>
<td>2.17±0.01</td>
<td>9.85±0.02</td>
<td>20.20±0.01</td>
<td>36.08±0.01</td>
<td>47.11±0.01</td>
</tr>
<tr>
<td>CSA3</td>
<td>2.08±0.01</td>
<td>4.09±0.02</td>
<td>10.20±0.01</td>
<td>20.64±0.02</td>
<td>27.73±0.01</td>
<td>42.25±0.02</td>
</tr>
<tr>
<td>CSA4</td>
<td>2.68±0.01</td>
<td>5.25±0.02</td>
<td>11.50±0.03</td>
<td>21.63±0.02</td>
<td>24.06±0.01</td>
<td>44.76±0.01</td>
</tr>
<tr>
<td>CSA5</td>
<td>3.18±0.01</td>
<td>6.71±0.02</td>
<td>12.51±0.02</td>
<td>23.21±0.02</td>
<td>20.89±0.01</td>
<td>43.24±0.01</td>
</tr>
<tr>
<td>CSco</td>
<td>3.51±0.03</td>
<td>2.07±0.02</td>
<td>1.50±0.04</td>
<td>13.92±0.04</td>
<td>9.06±0.00</td>
<td>10.92±0.04</td>
</tr>
</tbody>
</table>

Values are mean of triplicate measurements ± Standard Error of Mean (SEM)

Table 2: Mineral composition of compost (S. mombin wood dust and cow dung)

<table>
<thead>
<tr>
<th>Substrates</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
<th>Na %</th>
<th>Ca %</th>
<th>Mg mg/kg</th>
<th>Cu mg/kg</th>
<th>Zn mg/kg</th>
<th>Mn mg/kg</th>
<th>Fe mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSA1 Initial</td>
<td>5.85±0.01</td>
<td>0.14±0.00</td>
<td>0.14±0.00</td>
<td>0.87±0.00</td>
<td>0.76±0.00</td>
<td>0.36±0.00</td>
<td>13.53±0.00</td>
<td>78.03±0.00</td>
<td>82.26±0.00</td>
<td>63.45±0.00</td>
</tr>
<tr>
<td>Final</td>
<td>6.09±0.04</td>
<td>0.68±0.03</td>
<td>0.67±0.03</td>
<td>0.54±0.01</td>
<td>1.61±0.10</td>
<td>0.55±0.00</td>
<td>16.81±0.02</td>
<td>70.32±0.01</td>
<td>34.73±0.00</td>
<td>302.11</td>
</tr>
<tr>
<td>CSA2 Initial</td>
<td>4.74±0.02</td>
<td>0.14±0.00</td>
<td>0.63±0.00</td>
<td>0.83±0.02</td>
<td>0.62±0.01</td>
<td>0.04±0.00</td>
<td>11.49±0.02</td>
<td>71.47±0.01</td>
<td>76.56±0.03</td>
<td>57.94±0.01</td>
</tr>
<tr>
<td>Final</td>
<td>6.23±0.02</td>
<td>0.98±0.01</td>
<td>1.46±0.02</td>
<td>0.45±0.02</td>
<td>1.54±0.02</td>
<td>0.10±0.02</td>
<td>16.91±0.02</td>
<td>65.78±0.02</td>
<td>33.93±0.00</td>
<td>281.08</td>
</tr>
<tr>
<td>CSA3 Initial</td>
<td>4.04±0.01</td>
<td>1.10±0.00</td>
<td>0.63±0.00</td>
<td>0.74±0.03</td>
<td>0.53±0.04</td>
<td>0.04±0.00</td>
<td>8.59±0.00</td>
<td>57.7±0.00</td>
<td>71.73±0.00</td>
<td>55.43±0.03</td>
</tr>
<tr>
<td>Final</td>
<td>5.53±0.02</td>
<td>1.19±0.00</td>
<td>1.47±0.03</td>
<td>0.45±0.01</td>
<td>1.33±0.01</td>
<td>0.10±0.02</td>
<td>9.30±0.00</td>
<td>62.28±0.00</td>
<td>32.48±0.00</td>
<td>170.73</td>
</tr>
<tr>
<td>CSA4 Initial</td>
<td>3.80±0.00</td>
<td>0.74±0.00</td>
<td>0.55±0.00</td>
<td>0.70±0.03</td>
<td>0.43±0.03</td>
<td>0.03±0.00</td>
<td>7.62±0.00</td>
<td>49.92±0.00</td>
<td>31.91±0.00</td>
<td>43.72±0.00</td>
</tr>
<tr>
<td>Final</td>
<td>4.17±0.01</td>
<td>0.93±0.00</td>
<td>1.47±0.03</td>
<td>0.47±0.03</td>
<td>1.76±0.03</td>
<td>0.06±0.03</td>
<td>14.89±0.01</td>
<td>59.06±0.01</td>
<td>30.77±0.00</td>
<td>110.93</td>
</tr>
<tr>
<td>CSA5 Initial</td>
<td>3.18±0.00</td>
<td>0.42±0.00</td>
<td>0.52±0.00</td>
<td>0.64±0.01</td>
<td>0.85±0.02</td>
<td>0.06±0.04</td>
<td>7.60±0.00</td>
<td>32.96±0.00</td>
<td>22.51±0.00</td>
<td>36.22±0.00</td>
</tr>
<tr>
<td>Final</td>
<td>3.53±0.00</td>
<td>1.17±0.00</td>
<td>1.51±0.03</td>
<td>0.53±0.01</td>
<td>1.65±0.02</td>
<td>0.14±0.01</td>
<td>5.14±0.00</td>
<td>48.99±0.00</td>
<td>32.07±0.00</td>
<td>102.12</td>
</tr>
<tr>
<td>CSco Initial</td>
<td>2.05±0.02</td>
<td>0.51±0.00</td>
<td>0.50±0.01</td>
<td>0.60±0.01</td>
<td>0.88±0.02</td>
<td>0.03±0.00</td>
<td>7.52±0.00</td>
<td>28.46±0.00</td>
<td>18.72±0.00</td>
<td>39.94±0.00</td>
</tr>
<tr>
<td>Final</td>
<td>3.41±0.00</td>
<td>1.31±0.00</td>
<td>1.51±0.03</td>
<td>0.59±0.02</td>
<td>0.72±0.02</td>
<td>0.10±0.04</td>
<td>6.64±0.00</td>
<td>41.76±0.00</td>
<td>30.98±0.00</td>
<td>101.96</td>
</tr>
</tbody>
</table>

Values are mean of triplicate measurements ± Standard Error of Mean (SEM)

Key: CSA1- Spondias mombin and cow dung ratio 5:5; CSA2- Spondias mombin and cow dung ratio 6:4; CSA3- Spondias mombin and cow dung ratio 7:3; CSA4- Spondias mombin and cow dung ratio 8:2; CSA5- Spondias mombin and cow dung ratio 9:1; CSco 100%.
Table 3: Proximate composition of Vermicompost (S. mombin wood dust and cow dung)

<table>
<thead>
<tr>
<th>Substrates</th>
<th>fat content</th>
<th>crude protein</th>
<th>moisture content</th>
<th>ash content</th>
<th>fibre</th>
<th>dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Final</td>
<td>Initial</td>
<td>Final</td>
<td>Initial</td>
<td>Final</td>
</tr>
<tr>
<td>VSA1</td>
<td>1.30±0.02</td>
<td>1.02±0.02</td>
<td>9.56±0.02</td>
<td>2.62±0.02</td>
<td>44.60±0.02</td>
<td>10.37±0.02</td>
</tr>
<tr>
<td>VSA2</td>
<td>1.71±0.05</td>
<td>0.95±0.02</td>
<td>9.85±0.02</td>
<td>2.94±0.02</td>
<td>36.08±0.02</td>
<td>10.29±0.02</td>
</tr>
<tr>
<td>VSA3</td>
<td>2.08±0.02</td>
<td>0.94±0.02</td>
<td>10.20±0.01</td>
<td>2.49±0.02</td>
<td>27.73±0.02</td>
<td>10.25±0.02</td>
</tr>
<tr>
<td>VSA4</td>
<td>2.68±0.02</td>
<td>0.82±0.01</td>
<td>11.50±0.03</td>
<td>2.50±0.02</td>
<td>24.06±0.02</td>
<td>9.96±0.02</td>
</tr>
<tr>
<td>VSA5</td>
<td>3.18±0.02</td>
<td>0.87±0.02</td>
<td>12.51±0.00</td>
<td>2.42±0.02</td>
<td>20.89±0.02</td>
<td>10.03±0.02</td>
</tr>
<tr>
<td>VSCO</td>
<td>3.51±0.03</td>
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<td>1.50±0.00</td>
<td>3.62±0.02</td>
<td>9.06±0.02</td>
<td>10.65±0.02</td>
</tr>
</tbody>
</table>

Values are mean of triplicate measurements ± Standard Error of Mean (SEM)

Table 4: Mineral composition of Vermicompost (S. mombin wood dust and cow dung)

<table>
<thead>
<tr>
<th>Substrates</th>
<th>N %</th>
<th>P mg/kg</th>
<th>K mg/kg</th>
<th>Na mg/kg</th>
<th>Ca mg/kg</th>
<th>Mg mg/kg</th>
<th>Cu mg/kg</th>
<th>Zn mg/kg</th>
<th>Mn mg/kg</th>
<th>Fe mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSA1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Initial</td>
<td>5.85±0.01</td>
<td>0.14±0.00</td>
<td>0.14±0.00</td>
<td>0.87±0.00</td>
<td>0.76±0.00</td>
<td>0.36±0.00</td>
<td>13.53±0.00</td>
<td>78.03±0.00</td>
<td>82.26±0.00</td>
<td>63.46±0.00</td>
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<tr>
<td>Final</td>
<td>6.41±0.02</td>
<td>2.32±0.00</td>
<td>1.18±0.00</td>
<td>2.32±0.00</td>
<td>10.75±0.00</td>
<td>0.59±0.00</td>
<td>34.35±0.00</td>
<td>78.44±0.00</td>
<td>82.46±0.00</td>
<td>84.18±0.00</td>
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<td>VSA2</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial</td>
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<td>0.63±0.00</td>
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<td>11.49±0.00</td>
<td>71.47±0.00</td>
<td>76.56±0.00</td>
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<tr>
<td>Final</td>
<td>6.44±0.02</td>
<td>1.78±0.00</td>
<td>1.12±0.00</td>
<td>1.57±0.00</td>
<td>11.02±0.00</td>
<td>0.82±0.00</td>
<td>34.09±0.00</td>
<td>72.30±0.00</td>
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</tr>
<tr>
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<td>1.10±0.00</td>
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<td>34.08±0.00</td>
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<td>31.91±0.00</td>
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<td></td>
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<td>0.50±0.00</td>
<td>0.60±0.00</td>
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<td>0.03±0.00</td>
<td>7.52±0.00</td>
<td>28.46±0.00</td>
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<td>39.94±0.00</td>
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<td>Final</td>
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<td>0.71±0.00</td>
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<td>0.71±0.00</td>
<td>2.23±0.00</td>
<td>12.47±0.00</td>
</tr>
</tbody>
</table>

Values are mean of triplicate measurements ± Standard Error of Mean (SEM)

Key: VSA1- Spondias mombin and cow dung ratio 5:5; VSA2- Spondias mombin and cow dung ratio 6:4; VSA3- Spondias mombin and cow dung ratio 7:3; VSA4- Spondias mombin and cow dung ratio 8:2; VSA5- Spondias mombin and cow dung ratio 9:1; VSCO 100%

4. CONCLUSIONS

Changes in temperature were observed during the process. The various substrates prepared for composting and vermicomposting underwent changes in pH during the period (0 to 70 days). There was an increase in both macro and micro mineral in the substrate composted. As a result of the use of organic matter in the process of composting, there was release
of more nutrients that would be useful in the cultivation of mushroom. The different substrates used in the present study produced composts rich in K, P, Mg and Fe, which are important to plant nutrition and health.

REFERENCES


Molena, O. (1986). O Moderno Cultivo de Cogumelos, Nobel. Sao Paulo, Brazil, 170pp


